ISSUE 1 / 2010

DATA – FACTS – ANALYSIS

CUTEC-News

2010 – 20 YEARS OF CUTEC

CUTEC GOES INTERNATIONAL

Prof. Otto Carlowitz giving a talk at the Lower Saxony Energy Symposium in Goslar

The buzzwords globalisation and internationalisation are now used in every conceivable political, economic and cultural context, and they appear constantly in the news headlines. The terms signify a trend in today's world which is probably irreversible. The world is turning into a global community, and not just on the Internet. So what does that mean to us? At first glance, probably not very much. Our research institute is not particularly large, and it is located in a region that outsiders tend to associate with tourism and mining. However, because the initial impression is deceiving, I would like to tell you a bit about our international activities. To start with, since I took up my current post in 2000, we have had an International Affairs Coordinator on board who maintains and expands our international contacts. In addition, CUTEC scientists travel around the world to attend major international conferences, symposiums and similar events, where they meet scientists from many different countries who work in the same fields of research. Members of our team who attend these events give talks or put posters on display to present the results of their current work, discuss the results with other experts and keep up to date with the latest findings by listening to what other scientists have to say. These intensive information sharing sessions inject new ideas and open up new avenues of approach which help us in our research work here in Clausthal. The trips also have the welcome effect of raising our profile in the international scientific community. To enhance our reputation, we regularly publish in national and international scientific journals. Since outsiders are generally not aware of what we do, this issue will zero in on our international activities. Turn to Pages 3, 5 and 8 to read the "trip reports". You will find the interim results of our consulting project in Nigeria on Page 6. The final report on the BioWell project also appears in this issue of CUTEC News, and as promised in the last issue, we have included a review of the 2nd Lower Saxony Fuel Cell Summer School. As you can see, we are keeping up with the process of globalisation, and we have many contacts with the rest of the world.

I wish you and the rest of the CUTEC staff all the best for the New Year.

Otto Carlowitz

P.S.: To complete the picture of our international activities, I should add that we are the owners of several international patents, we regularly host visiting scientists from all parts of the world, and for many years we have helped organise the Advanced Oxidation Processes (AOP) conferences. In the spring, we shared information with you about the fifth event in this series, which took place in Berlin.

BIOWELL PROJECT BROUGHT TO A SUCCESSFUL COMPLETION

At the final meeting that took place at CUTEC on May 8th, 2009, the curtain came down on the BioWell project which received 1.3 million euros in EU subsidies. Dr. Schläfer and International Affairs Coordinator Dr. Onyeche acted as coordinators on this bioprocess technology project (see CUTEC News 2/2006).

A comprehensive review of the project, which posed significant scientific and engineering challenges, and a preview of opportunities for exploiting the results were presented at the meeting. The final report was handed over, and special recognition was given to the way in which the European project was organised, bringing major international partners from different disciplines around the table to solve a specific task. The successful outcome was primarily the result of good balance in the consortium and the excellent way in which the project partners managed the interfaces. Over a period of 30 months, a team consisting of two users, four systems manufacturers and three research organisations developed a new method for enhancing the efficiency of biogas production. The new technique is based on pre-treatment of biomass (see picture above).

Project consortium with the management team Dr. Onyeche, 5th from right / Dr. Schläfer, 3rd from right (CUTEC) and project managers from the international research institutions and companies which contributed to the project, gathered in front of the BioWell demonstration system at CUTEC

The initial goal of the project was to systematically evaluate the different biomass pre-treatment options which can be used to activate the biological digestion process and to analyse the energy efficiency on a laboratory and pilot scale. Optimisation and assessment of selected processes were carried out on an industrial scale during the second phase of the project.

The results of comparative analysis give equipment manufacturers and users in the biogas industry direct access to practical information which is also significant in the international scientific context. The high-pressure homogenisation process, for example, which already has a proven track record in sewage sludge pre-treatment at CUTEC, produces the highest increase in yields and is highly energy efficient with biomass that has low viscosity and a low particle count. The process, however, proved to be fault-prone during practical testing on fibrous material. The Hollander beater, a technology which is borrowed from the paper industry, produced a significant increase in yields on biomass with a high fibrous content, and energy consumption is also moderate. This technique actually turned out to be more reliable. The project produced a selection matrix which allows users to determine the best pre-treatment method for increasing biogas production efficiency depending on the biomass feed stock they are using and other parameters.

This new technology and information help SMEs to develop and deliver tailored solutions which increase the efficiency of biogas production systems. This translates into a market advantage for biogas plant operators and the SMEs involved. Following completion of the project, the companies will now proceed with patent applications and commercial exploitation of the new technology. The existing links to AgriCapital mean that there is another potential investor in the consortium, which can take advantage of the project results along side of the equipment suppliers and biogas plant operators. The major goals on the joint European BioWell project were to exploit the new technology on a commercial basis and strengthen the position of SMEs over the long term, and these goals have been achieved.

We would also be glad to develop research strategies for your task, help you acquire funding and handle your project through to its implementation. (schl)

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Internet: www.cutec.de
Publication:
Several times a year at irregular intervals.
Issues can be ordered from the address above at no charge.
Send an E-mail to:
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CUTEC ON THE WORLD SCIENTIFIC STAGE

The editorial already contained the key piece of information about this topic: CUTEC scientists often take business trips to countries which have strange and exciting cities and breathtaking, exotic landscapes, but the only glimpse they get of their surroundings is what they can see on the way from the airport to the hotel or when they are going from the hotel to the event venue. Time is at a premium on these trips. The agenda is tightly packed, events often take place in parallel at different locations, and the venues (usually conference or exhibition centres) around the world essentially all look the same. However our presence at these events is vital, because it gives CUTEC scientists the opportunity to get together with scientists from other countries and take part in presentations and discussions on our own research results or results obtained by others and keep up with the latest developments. Read on to find out more about the various events. (he)

Bio 2009 in Atlanta / USA

BIO, the world flagship event in the biotech industry, was held this year on May 18th - 21st at the World Congress Center in Atlanta, USA. The theme of this year's event was "Heal, Fuel, Feed the World". More than 20,000 international experts from the fields of biotechnology, bio process engineering, environmental technology and the pharmaceutical industry gathered to attend presentations and discussions on the latest developments and findings.

The Federal Republic of Germany put on a joint exhibition at the show on more than 600 m² of space. Along with 45 other German exhibitors, CUTEC took the opportunity this year for the first time to be part of the German delegation. This was a very cost-effective way of raising the CUTEC profile at BIO. International Affairs Coordinator Dr. Onyeche handled the liaison activities. We put the latest version of our GMZ III meter on display at the North German Pavilion. This high-throughput digestion device measures biogas volumes with micro litre accuracy, and it now also has a built-in gas concentration measurement feature.

Dr. Schläfer (left) shares information about the CUTEC biogas measurement cell at the joint German booth in Atlanta

The CUTEC booth attracted considerable attention throughout the show. We had many fruitful discussions with potential users from industry and the research community (see picture above).

We took the opportunity to present our bio (gas measurement) technology for the regenerative energy market, which is still in its early stages in the USA, and to get a feel for the market potential. The supporting programme of forums and partnering events also presented an excellent platform for establishing or reinforcing international contacts and partnerships. During visits to other areas of the show that were dedicated to specific themes, we were able to gather a wealth of information on the current state of bioprocess technology. This knowledge can help us set the future direction as we expand this area of activity at CUTEC. (schl)

Hydrogen + Fuel Cells 2009 in Vancouver / Kanada

For years, Canada has been one of the leading developers of fuel cell technology. More than 1,000 participants, speakers and exhibitors followed the invitation from the Canadian Hydrogen and Fuel Cell Association (CHFCA) to remain up to date with the latest developments and findings by attending the Hydrogen + Fuel Cells 2009 International Conference and Trade Show (HFC2009).

Leading Canadian fuel cell companies including Ballard, Hydrogenics, Dynetek Industries, Versa Power Systems and others attended the event.

The nine-day Hydrogen Road Tour 2009, which started out in San Diego and covered 2,700 km with a fleet of fuel cell cars, reached its destination in Vancouver, and discussions took place on the next steps that need to be taken prior to worldwide market introduction of fuel cell vehicles.

On behalf of CUTEC, Mr. Dietrich presented the design of a high-temperature fuel cell system which uses the anode waste gas of an SOFC to reform propane, thereby significantly increasing the efficiency of the overall system. Joint results of hardware development conducted by the Zentrum für BrennstoffzellenTechnik in Duisburg and CUTEC as part of the IGF project "Development of a new approach to propane powered SOFC fuel cells based on reforming with partial andode waste gas recycling" (IGF-Project No. ZN 251) were presented for discussion and were well received by the experts.

One of the fuel cell cars from the Hydrogen Road Tour 2009, which travelled 2,700 km before it reached Vancouver

Besides being able to present the results of our own research to the international fuel cell community, we also had the opportunity to review technology development around the world and establish international contacts. (di)

Continued on page 8

LOWER SAXONY ENERGY SYMPOSIUM IN GOSLAR

The 3rd annual Lower Saxony Energy Symposium was held in Goslar on November 5th – 6th. Around 220 individuals from the world of politics, business and science including Lower Saxony Minister President Christian Wulff got together for 2 days in the historic royal palace in Goslar to share views on energy and mobility. (Source: Press release, University of Applied Sciences in Clausthal, 6 Nov 2009). Prof. Carlowitz gave a talk at the event, and CUTEC also had its own exhibition stand (picture at the right) at the energy symposium.

Prof. Carlowitz explains the diagram which shows the energy flow at the decentralised straw thermal power plant to Prof. Steiger from Volkswagen

The following issues were discussed at a series of talks that were given in parallel:

- new sources of energy for mobility
- storage systems
- energy distribution and mobility and
- new propulsion technologies

One key issue that cut across all topic areas was the question of what propulsion technology our cars will have in the future. Input from the automotive industry made it clear that research is proceeding in all directions. The options include engines that run on alternative fuels such as BtL, CNG and LPG as well as electric and hybrid cars and hydrogen cars with fuel cell propulsion systems.

The attendees had the opportunity to take a test drive in a MINI E to experience the current generation of electric cars.

The range of the Mini E is quoted as 168 kilometres before the battery needs recharging. Hopes of extending the range of electric cars depend on the development of higher-capacity storage systems (batteries) and the availability of electro fuelling stations (charging stations).

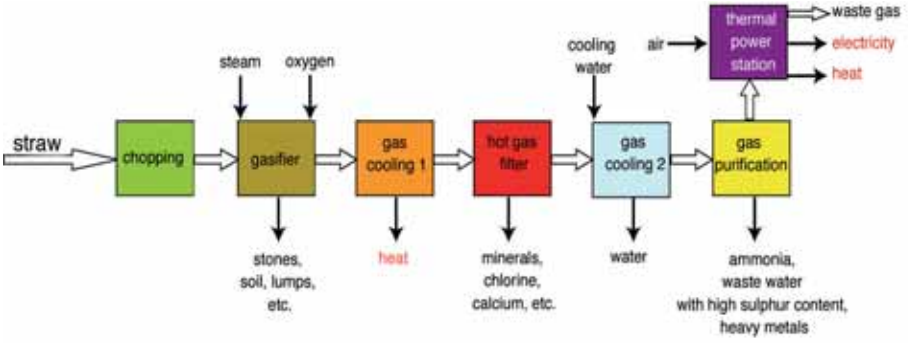
This raises the next major issue, namely how to generate the electricity needed to power electro-mobility. The amount of electricity which is generated from renewable energy, e.g. hydroelectric, wind, solar, geothermal and biomass, will have a crucial influence on the environmental viability of electro-mobility. Off-shore wind parks appear to have significant potential. Lower Saxony is a leader in wind energy in Germany, and the expansion of off-shore wind generation is expected to benefit the local economy.

Estimates indicate that off-shore wind capacity in the whole North Sea area could reach 100 GW. Only 1.5% of that capacity is currently in place. High-capacity storage solutions are needed to buffer high wind loads and bridge periods of “calm” to maintain a continuous, uniform supply of electricity from wind power. There are still a lot of challenges to overcome in the coming years, such as installation and anchoring of heavy foundations on the seabed and installation and expansion of intelligent power distribution networks.

Biomass in the regenerative energy mix can compensate for times when power cannot be generated from wind and solar energy due to adverse weather conditions. The energy contained in the biomass can be converted to heat, electrical energy and/or combustion, fuel and chemical raw materials.

In his talk on “Energy Efficiency during Gasification of Biomass", Prof. Carlowitz outlined CUTEC's strategic roadmap for decentralised biomass processing, and it also contained an explicit implementation example (picture of a straw thermal power plant) as well as concepts for converting synthetic gas to chemical raw materials and fuels.

The key message from the Energy Symposium was that Lower Saxony, based on its extensive agricultural acreage (biomass production), coast line (off-shore wind power) and hydroelectric power, has enormous potential to increase the proportion of renewables in the energy mix over the coming years. (wo)



Grafic of a straw thermal power plant

Lower Saxony Minister President Christian Wulff, Dr. Theodore Onyeche, Ambassador Dr. Klaus Scharioth, German Emgassy, Washington D.C. (left to right)

CUTEC ACCOMPANIES LOWER SAXONY MINISTER PRESIDENT CHRISTIAN WULFF ON US TRIP

The Minister President of Lower Saxony, Christian Wulff, travelled to the US with a 50-member delegation on September 29th – October 5th, 2009. Executive Board members from Volkswagen, Deutsche Messe AG, RWE and Nord/LB along with managers from the SME sector and high-level representatives from the universities in Hannover, Göttingen, Braunschweig and Clausthal were part of the delegation. The list of other dignitaries who made the trip included the President of the University of Applied Sciences in Clausthal, Prof. Thomas Hanschke, his Vice-President and head of the Lower Saxony Energy Research Centre (EFZN), Prof. Hans-Peter Beck and Prof. Kurt M. Reinicke who is in charge of the Oil and Gas Institute at the university in Clausthal. International Affairs Coordinator Dr.Theodore Onyeche represented CUTEC in the US.

The itinerary included stops in Los Angeles, Houston, Washington, Atlanta and Chattanooga. The visitors held discussions with business and political leaders and attended the German Unity Day reception in Washington, D.C. The trip gave CUTEC a good opportunity to raise its profile and make new contacts with people who make the decisions in the US.

Energy policy was the main topic on the agenda. The delegation attended a climate conference in Los Angeles, which was convened to support the 2009 Climate Summit in Copenhagen. The Governor of California, Arnold Schwarzenegger, who is an avid supporter of increased climate protection in the US, organised the Governor's Global Climate Summit for the second time. In addition to activities for all members of the delegation, Minister President Wulff held individual discussions with high-ranking political and business leaders. Dr. Onyeche was selected to accompany Minister President Wulff to a meeting with Chad Deaton in Houston, Texas on innovative use of oil and gas. Chad Deaton is a president of Baker Hughes Corporate, one of the world's four largest oilfield service companies, which produces leading-edge drilling and measurement systems at its site in Celle. The entire delegation then travelled to Rice University in Houston to take part in an Energy Forum which focused on the energy industry of the future. Exxon Mobil was represented at the forum. An energy partnership agreement was signed between Rice University and the University of Applied Sciences in Clausthal. The delegation was invited along with around 3,000 other guests to attend a reception at the German Embassy in Washington, D.C. on German Unity Day. Some of the members of the delegation highlighted Lower Saxony's importance as an energy region with a good scientific, research and cultural pedigree. Items on display included a new type of solar cell and a 7.2 meter high air display of a wind turbine. CUTEC had its own stand which was manned by Dr. Onyeche and focused on the theme "Synthetic fuels from renewable raw materials". (on/sz)

Lower Saxony Minister President Christian Wulff with Stefan Schröder, Lower Saxony Aviation Project Leader (left to right)

REPORT FROM THE WORKERS COUNCIL

Now that the German parliamentary elections are over, more elections are just around the corner. Elections for the Workers Council are held every four years, and 2010 is an election year. This will be the fifth Workers Council to be elected at CUTEC. There are five members on the Workers Council, which is the number prescribed for companies with up to 100 employees. The Election Committee, which organises the elections, has three members who are appointed by the Workers Council ten weeks prior to the election. Every employee over 18 years of age is eligible to vote. The Election Committee prepares the Election Register which contains the names of eligible voters. The Election Register and the Election Rules are posted in the company for review.

Any employee who is eligible to vote and has been working at the CUTEC Institute for at least six months has the right to stand as a candidate for the Workers Council. Candidates are nominated prior to the election by obtaining signatures from 5% of eligible voters (five signatures) who enter their names on a list to support the nomination. Ideally, we would like the number of candidates to be twice the number of members. The Workers Council elections will take place in the period between March 1st and May 31st 2010. The current team hopes that there will be a good turnout for the election and that a large number of individuals will express an interest in standing as candidates. (kie)

CUTEC PROVIDES ENVIRONMENTAL ADVICE TO THE GOVERNMENT OF ABUJA IN NIGERIA

CUTEC has maintained close contacts with the government in Abuja since 2002. Our status as a public institution and our high level of expertise have been very beneficial in building up a relationship of trust, and we were awarded a contract in July 2006 to provide environmental consultancy for a period of 5 years. Under the agreement, CUTEC will provide consultancy in nine policy areas including environmental audits, a review of existing legislation, development of environmental goals, a review of existing waste disposal facilities, development and conceptual design of an environmental laboratory, waste management strategy and treatment facilities as well as public relations work and training of Nigerian staff in Germany.

Gosa waste disposal site, Abuja

Environmental training at CUTEC is particularly important, because it helps engineers and admin staff to understand the big picture in their own surroundings. The waste, waste water and air pollution training programme includes a theoretical analysis of the problems as well as practical solutions which the course participants can then witness first hand. What they see makes a very lasting impression, and in Abuja we can continually highlight the parallels to what has been taught during the training sessions. It has been our experience that practical presentation of solutions plays a major role in the success of training activities.

Problems with waste treatment have come to light during the course of our activities in Abuja. Fires at waste disposal sites caused by the activity of thermophilic bacteria, extremely toxic leachate and disastrous waste collection are typical of the situation in Abuja. Food is still grown in

Leachate conduit at the waste disposal site in Gosa, Abuja

areas where fires burn underground. Cattle graze in the rubbish at the large waste disposal site, and children play in the leachate.

Burning refuse (gas fire)

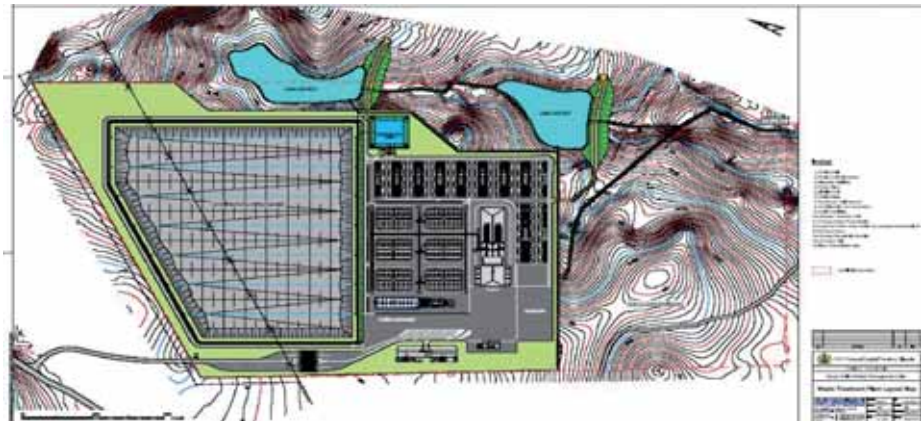
CUTEC has been aware for a long time of the types of problems that are quite common outside of Europe. However, our team is still shocked every time they see the children face to face. Waste collection has been privatised, and citizens have to pay around €100 to purchase their dustbins. These purchases are problematic, because no high-quality dustbins are produced. Import without government approval is banned by law. Dustbins are in such demand that they have to be chained to the latrines. The refuse collection vehicles are the next problem, because they have no lifting equipment. The 1,100 litre bins are dumped out on the street, and the workers load the rubbish into the vehicles with their bare hands. Some of the refuse has already reached the acid fermentation stage, which makes this type of rubbish particularly problematic.

As the result of intensive discussions by our team, 50 new refuse collection vehicles and 8,000 new dustbins have been purchased. If all goes well, the situation will have improved before Christmas.

With the support of an engineering firm in Lower Saxony, CUTEC delivered a proposed design for an environmental laboratory and plans for a waste treatment and disposal facility with an annual capacity of 20,000 tonnes. The discussions on financing continue, because inclusion of funds in the annual budget takes a lot of convincing. This is an ongoing challenge for the CUTEC team.

Our team spends about one week a month in Nigeria, and we now have the support of Nigerian engineers. As a result, we can maintain a more or less constant presence for the customer. Besides having a local presence, we stay in daily contact by Internet and telephone, and Dr. Onyeche is also available late in the evenings for discussions with the customer by phone.

This personal commitment solidifies the mutual trust between the government in Abuja and CUTEC. (on)



Design of a waste treatment and disposal facility in Abuja

2ND LOWER SAXONY FUEL CELL SUMMER SCHOOL – A REVIEW

The students conducted experimental trials on fuel cells with great enthusiasm

Students during a maths practical

A week of lectures, practical trainings, discussions and preparation of presentations cut short the well-deserved summer holidays for 45 students and postgraduates from all across Lower Saxony. They took part in the 2nd Lower Saxony Fuel Cell Summer School which was held prior to the start of the new semester. The students were very satisfied with the event, and they would welcome the opportunity for other students to attend a similar event next year.

Speakers at the Summer School included representatives from the major fuel cell companies in Lower Saxony such as Mr. Barth (EWE), Dr. Klein, Dr. Schmitz and Dr. von Unwerth (Volkswagen), Dr. Otterstedt (H.C. Starck) and Dr. Hickmann (W. Eisenhuth). Talks were also given by experts from Mecklenburg-Western Pomerania (Dr. Boltze, Enerday), North Rhine-Westphalia (Mr. Lohren, Ceramic Fuel Cells) and Saxony (Mr. Grahl, Staxera).

Local scientific experts explained the basic technology used on various types of fuel cells. The topics included thermodynamics, materials, components, assemblies and systems. The list of high-profile lecturers included Prof. Wittstock (IRAC Institute, University of Oldenburg), Dr. Conrad (Next.Energy), Prof. Caro (PCI, Leibniz Universität Hannover), Prof. Borchardt and Dr. Dörrer (IMET, Clausthal University of Technology), Dr. Lindermeir (CUTEC), Mr. Pinnow and Mrs.Lezniak (ICVT, Clausthal University of Technology) and Mr.Wiechecki (IfB, Clausthal University of Technology).

Students were also able to perform hands-on experiments on Heliocentris fuel cells and to simulate what goes on inside an SOFC using a Matlab model developed by the Technische Universität Braunschweig (with the support of Mr. Chen and Mr. Schlitzberger from IWBT). In addition, they had the opportunity to conduct practical experiments during excursions to the Volkswagen research facilities in Isenbüttel, the Chemical Process Technology, Metallurgy and Mining Institutes in Clausthal and the CUTEC Institute. The students analysed the results of their own experiments and presented them to the group.

The students benefited from a balanced mix of scientific bases knowledge transfer, presentations of the latest research results and very interesting practical experiences, which should prove very helpful to them as they weigh up the pros and cons of working with fuel cells when they are making their future career choices.

Following the great success in 2008, the Steering Board of the Initiative Fuel Cell and Battery Technology Lower Saxony approved the continuation of this event series. Again this year, participating companies and the universities in Lower Saxony provided most of the funding. The persons who attended the event only had to pay a very modest fee of € 50 which included hotel accommodation and cafeteria meals.

The Summer School was organised by Mr. Dietrich from the Competence Cluster Science of the state's Fuel Cell and Battery Technology Initiative together with Prof. Seume from the Institute of Fluid Dynamics and Turbo Machines at the Leibniz Universität Hannover, who hosted the event. Financial administration was handled by the Environmental Institute at the Clausthal University of Technology.

The feedback from the participants was overwhelmingly positive, and each of them intends to spread the word when they are back at university. If they do that, there will certainly be enough interest to stage the 3rd Lower Saxony Fuel Cell Summer School next year. The lecturers shared the enthusiasm of the students, and they are also in favour of staging the Summer School for a third time. "I would be very happy to come back next year to give lectures at the Summer School," said Dr. Klein from Volkswagen Corporate Research on behalf of the rest of the teaching staff. (di)

Lecturers and students at the Summer School

Continuation from page 3

CUTEC ON THE WORLD SCIENTIFIC STAGE

Joint biogas project with Thailand

A visit to our international partner

The Quality Management in Biogas Production and Gas Cleaning Technologies Project between CUTEC and King Mongkuts University of Technology Thonburi (KMUTT, Bangkok) is sponsored by the German Academic Exchange Service (DAAD). Dr. Schläfer paid a visit to our partners in Thailand in April of this year. A member of the CUTEC team, Mr. Siemers, who is currently working as a visiting scientist at the Bankok University of Technology, and International Affairs Coordinator Dr. Onyeche made the initial contact to Thailand. The project was initiated by Prof. Sievers, who is head of the Physical and Biological Process Department, and he is also in charge of the project. Visitors from the university in Thailand visited CUTEC last year to a look at the current state of German biogas measurement technology and the biogas test facilities.

This international partnership is of particular importance to CUTEC, because Thailand is a rapidly developing Asian country which has enormous potential for biogas production from agricultural waste feedstock. The main crops and biggest export products are rice and cassava (manioc) which is mainly processed into starch (tapioca). Discussions were held with the visitors from Thailand on the current status of the project and the future course of action. They also had the opportunity to visit a starch production plant and gather first-hand information about the treatment process for organic residue which is used during cassava processing.

The goal of the 2-year collaborative project is to foster bilateral information exchange between CUTEC and KMUTT on the current state of research and technology and to jointly explore opportunities for improving biogas technology. Gas treatment technology in Thailand lags behind German technology, and another goal is to analyse the suitability of different gas purification techniques for use in Thailand. This promising development project offers European (and especially German) companies that

Organic residue and waste water from starch production in Thailand

supply the right technology a wealth of opportunities in the Thai market. Once the project has reached a successful conclusion, CUTEC will have the opportunity to apply for follow-on projects. (schl)

ASME 7th International Fuel Cell Science, Engineering & Technology Conference in Newport Beach / USA

The American Society of Mechanical Engineers (ASME), which plays a similar role to VDI in Germany, organises high-profile conferences which focus on the current state of development in a variety of technologies. International research institutions take the opportunity to get together at the annual fuel cell conference. During evaluation of extracts that were submitted prior to the conference in Newport Beach, a paper put forward by the University of Braunschweig IWBT Institute, the Fuel Cell Technology Centre in Duisburg and CUTEC entitled "Using Anode-Offgas Recycling for a Propane Operated Solid Oxide Fuel Cell System" was selected along with about a hundred other papers for presentation at the conference.

Following plenary talks by contributors such as FuelCell Energy, Plug Power, Rolls-Royce Fuel Cell Systems, Toyota and UTC Power, the latest scientific findings in the field of fuel cell research were presented in four sessions that ran in parallel.

In Newport Beach, Mr. Dietrich presented the results that were achieved by the project team including the hot gas injector which was developed in-house (CUTEC), the reformer/burner reactor (ZBT), the overall design using the high temperature fuel cell which was provided by Staxera GmbH, and the results of dynamic process simulation carried out by IWBT. A number of suggestions for further project activity and new ideas for future projects were put forward during the ensuing discussion of the results. (di)

11th Grove Fuel Cell Symposium in London / GB

The Grove Fuel Cell Symposium (named after the inventor of the fuel cell, Sir William Robert Grove, 1811-1896) is Europe's flagship fuel cell event, and it is held every two years in London. Experts from around the world gather at the symposium to discuss fuel cell commercialisation. The event features a large exhibition by a number of suppliers, a series of talks about legislative, commercial and technical issues relating to market introduction and a poster session to highlight the latest findings on the deployment of fuel cells.

The team* that carried out the project described in the previous article presented the poster "Propane driven SOFC system using anode offgas recycle" at the symposium. This was the first opportunity that the team had to present all aspects of the project including hardware simulation, stack characterisation, simulation, control, assembly and integrated system operation. The poster was judged to be one of the 10 best designed posters, and the authors were very pleased to receive that recognition. (di)

* The Electrical Engineering Institute at the Clausthal University of Technology, the Heat and Fuel Technology Institute at the Technische Universität Braunschweig, the Fuel Cell Technology Centre in Duisburg and CUTEC Institute GmbH in Clausthal-Zellerfeld